Note on a New Deep-Sea Echiuroid,

Protobonellia Mitsukurii,

nov. g. et *nov. sp.*

BY

Iwaji Ikeda.

In September of 1905, I had an opportunity, through the generosity of Professor MITSUKURI of the Tokyo Imperial University, to examine an interesting specimen of a deep-sea Echiuroid, which was obtained by Mr. AOKI with a long line in the Sagami Bay at a spot 300 fathoms deep. On dissecting it, I found at once that it was a new form with many points of interest. I propose to institute a new genus and species on it under the name of

PROTOBONELLIA MITSUKURII *nov. g.* et *nov. sp.*

The body (in the preserved state) measures 24 mm. including the proboscis which is 15 mm. in length. The body-proper is a long ovoidal form, 9 mm. long and 5 mm. wide. The integument is almost colorless by the action of the preserving fluid and is so thin, smooth, and transparent that the ventral nerve-cord and some parts of the intestinal loop shimmer through it, except the parts near the ends where papillary bodies are closely set (fig. 1.). Over the remaining regions the papillae are much more minute and sparingly distributed. No regular arrangement is detected in all of the papillae. About 1 mm. from the anterior end, there are two yellow ventral hooks, each ending with an inwardly curved sharp point. Both are carried on a small papilla-like elevation (see fig. 1.). About 1 mm. behind the hooks is a small depression on the left side of the nerve-cord. This is the external aperture of the single segmental organ. The anus is

Fig. 1.—Ventral view of the specimen, ×3.

situated at the ordinary position, and is not guarded by the caudal spines.

The proboscis is exceedingly slender as compared with the body proper. Since the proboscis is a very contractile organ, it would have been much longer when alive than it is now. The organ has a deep longitudinal groove along its ventral side, giving it a tubular appearance. The tip of the proboscis is somewhat truncated. The ventral groove abruptly closes towards the mouth, forming a large oral funnel. The proboscis is colorless and is covered with fine wrinkles.

The general aspect of the viscera *in situ* is shown in fig. 2, which represents the animal opened along the mid-dorsal line. The alimentary canal is cut across at one place, so as to expose the segmental organ and the blood vessels; the gonad (*ov*) has been accidentally displaced to the right being torn off from the ventral vessel.

Alimentary canal.—The alimentary canal is held in definite course by numerous fine threads of muscles arising from the integument. Various parts of the intestinal tract are very poorly demarkated in the alcoholic specimen. The collateral intestine (*ci*) is distinctly developed along the median ventral line of the mid-gut; both its extremities are marked in the figure with †. Of these, the anterior end nearly coincides with the posterior border of the ring-like sinus known as the "heart" (*ht*). The mid-gut and the collateral intestine taken together make up about one third of the length of the entire canal. The hind-gut is relatively long, occupying about one fifth of the intestine. As is the case with many other Echiuroids, it is distinguishable from the mid-gut by the presence of the ciliary groove instead of the collateral intestine.

Anal glands.—To the terminal portion of the hind-gut near the anus are appended the anal glands, two relatively short (about 5 mm. long) and slender tubes bearing numerous and long-stalked funnels (fig. 2, *ag.*). They are destitute of any attaching muscles, the free ends floating in the coelom. It is somewhat dendritic, recalling the same organ of some

Bonellian species. The main stem is very narrow; its proximal part however abruptly dilates into a thin-walled vesicle near the rectal junction. This dilation does not seem to be an artefact; for the condition is the same both in the right and left glands. Both the vesicular and the tubular parts are provided with the funnels as well. The main stem gives off a certain number (12—15) of side-branches, each of which bears 2-4 long stalked funnels. The latter become gradually fewer towards the anterior end of the main stem. No rectal gland is present.

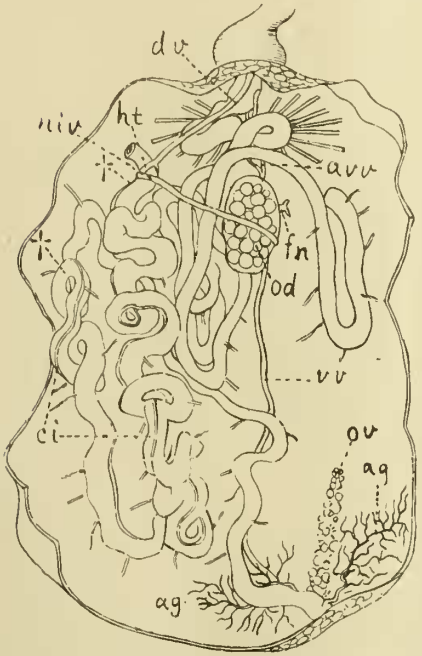


Fig. 2.—Viscera *in situ*, highly magnified. *ag*—anal glands; *avv*—accessory ventral vessel o "ring-vessel"; *ci*—collateral intestine; *dv*—dorsa vessel; *fn*—funnel of oviduct; *ht*—heart; *niv*—neuro-intestinal vessel; *od*—oviduct; *rm*—radial muscles of the hooks; *vn*—ventral nerve-cord; *vv*—ventral vessel.

Ventral hooks.—When examined from inside of the integument, the radices of the ventral hooks are seen as two comparatively long rods, the sheaths of which have a very complex system of muscles (figs. 2 and 3, *rm*). The so-called radial muscles are exceedingly numerous, arising from the integument in several apparently concentric rows and being inserted not only to the apex, but also to the whole length of the radix, (see fig. 3). Of these muscles, the innermost ones are arranged in one plane, thus giving to the whole group an appearance of a half cone. There is another peculiarity concerning the shape of the interbasal muscle (fig. 3, *im*) of the ventral hooks. Contrary to all cases hitherto known, this muscle is not a slender thread extending between the apices of the hook-sheaths, but represents a very wide membraneous structure stretching between the whole length of the two sheaths. It was ascertained under a high power that the majority of the component fibres of this muscle run horizontally, the rest pursuing an oblique course. Owing to the fine-

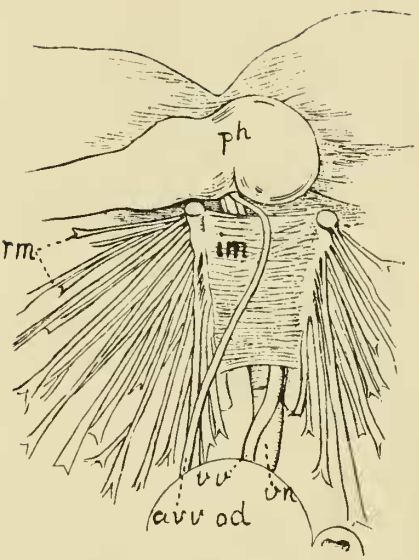


Fig. 3.—Magnified view of the radices of the ventral hooks together with the radial muscles. *avv*, *od*, *rm*, *vn*, and *vv*, same as in fig. 2; *im* —interbasal muscle, *ph*—pharynx.

ness and the irregularity of the course taken by the fibres, the muscle as a whole appears shiny.

Blood vessels.—The vascular system is in general the same as in other Echiuroids (*e.g.*, *Thalassema* and *Bonellia*). In the body proper there occur two principal longitudinal vessels, *i.e.*, (1) the ventral vessel (fig. 2, *vv*) along the ventral nerve-cord (*vn*) and (2) the dorsal vessel (*dv*) extending between the proboscis basis and the "heart" (*ht*) which embraces the posterior part of the fore-gut. The "heart" and the ventral vessel are connected to each other by a short vessel or neuro-intestinal vessel (*niv*), which originates about 2 mm. behind the insertions of the ventral hooks. A little anterior to the above spot there arises another more slender branch which runs forward beyond the interbasal muscle and is finally embedded in the proboscis (see *avv* in figs. 2 and 3). Anteriorly this accessory ventral vessel, if I may so call it, joins the ventral vessel at a point where the latter enters the proboscis.

Sexual gland.—The position of the sexual gland is as in other forms, *i.e.*, along the dorsal line of the posterior part of the ventral vessel.* It is a moniliform string about 5 mm. long. As the specimen is a female, the gonad is made up of a great number of variously sized ovarian eggs (fig. 4). The youngest eggs are clustered on the ventro-lateral side of the ovary, but more on the ventral side where the germinal epithelium passes over the peritoneal covering of the ventral vessel. The remaining surface of the ovary is thickly studded with more or less advanced oogonia (fig. 4). The

* The gonad is represented in fig. 2 in an unnatural position for the reason before mentioned.

oogonium of various growth-phases has at its free end a cap of a compact nutritive cell-mass, appearing, as in *Bonellia*, as a small cone with blunt apex. Fully grown oogonia of about 0.45 mm. in diameter found in the coelom or in the oviduct are also accompanied with the cell-mass which has become a little reduced in size.

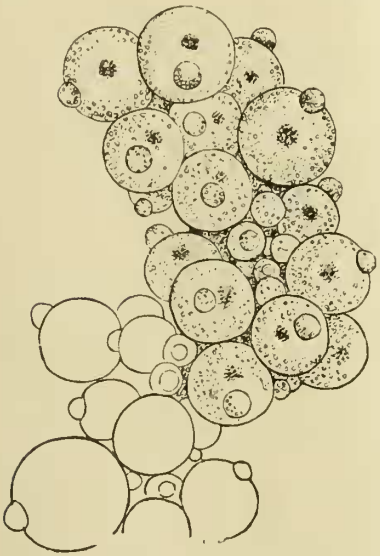


Fig. 4.—A portion of ovary, ×35.

Segmental organ or oviduct.—Only the left oviduct is present attached close to the ventral nerve-cord (fig. 2, *od.*). It is cocoon-shaped, thin-walled, and provided with a short stalk. The whole structure measures about 3.5 mm. long and about 1.3 mm. thick. It seems however to have been a more spacious sac in the living state. The internal aperture of the organ is of a similar shape and position as is known in *Bonellia*; it is a wide and notably fimbricated funnel attached to the distal end of a slender tube. The latter opens into the sac near the stalk or duct of the organ. The sac is filled with full grown spherical eggs of about 0.45 mm. in diameter.

Systematic position.—From the foregoing description, it will be seen that this species bears, so far as the internal anatomy is concerned, close affinity to the Echiuroids belonging to the genus *Bonellia*. It agrees very closely in almost all essential characters with the female form of *Bonellia*, viz., with respect to the ventral hooks, the alimentary canal, the anal glands, the vascular system, the single oviduct, and ovarian eggs. The only point of difference from *Bonellia* is in the shape of the proboscis. But it must here be noticed that the proboscis of the Echiuroids in general is a structure which varies more or less even in one and the same genus. *Echiurus unicinctus* for instance, is almost proboscisless as compared with other *Echiurus* species; just the reverse is the case with *Thalassema taenioides*, in which the organ can be extended to a length three or more times

as long as the body proper. Similar instances are also known in *Hamingia arctica* and *H. sibogae*. Lastly, it is a well proved fact that the peculiar bifid proboscis of female *Bonellia* arises ontogenetically from the ordinary unbranched form of other Echiuroids.

The second point to be considered in comparing the present species with *Bonellia*, is whether or not the sexual dimorphism found in *Bonellia* and *Hamingia* is present in the species under consideration. In order to determine this interesting problem, special attention was paid, while dissecting the pharynx and the oviduct, in the search for parasitic males that might be found therein. But all my efforts were unsuccessful. Notwithstanding this failure, I am inclined to believe in the sexual dimorphism of the present species, because of the general agreement in anatomy of both genera (*Protobonellia* and *Bonellia*), especially in regard to the structure of the oviduct and to the ovarian eggs. Moreover it is not unfrequent that parasitic males are not found in the female however mature this may be, as for instance in *Bonellia minor* as observed by myself and in *Hamingia sibogae* as recorded by SLUITER.*

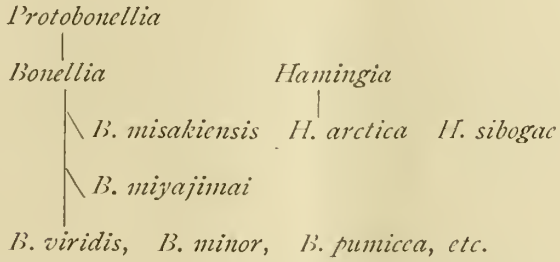
Now, as to the affinity which the present new species bears to other Echiuroids. It must be admitted that this form is remotely related to the genera *Echiurus* and *Thalassema*, but more closely to the Bonellian Echiuroids. Of the latter, again, *Bonellia* stands more intimately allied with it than any other genus. *Hamingia*, the only other genus of the Bonellidae, agrees with the present species in having similar proboscis, while it differs from the latter in wanting the ventral hooks. It may be added that, two remarkable characteristics of *Hamingia sibogae*, as described by SLUITER, are the total absence of the anal glands and of the collateral intestine. Judging from what has been said, especially with regard to the proboscis and the ventral hooks, it cannot be doubted that the present new species represents a very primitive type of the Family Bonellidae. I think, therefore, it is necessary to found a new genus for this new species, which I take pleasure in naming in honor of Professor MITSUKURI: *Protobonellia Mitsukurii*.

* Die Sipunculiden und Echiuriden der Siboga-Expedition. Siboga-Expedite XXV, 1902.

Diagnosis of the genus *Protobonellia*.

Proboscis long and tubular, not bifid. Body proper with two distinct ventral hooks, without anal spine. Single genital duct with a long-stalked and fimbricated funnel; anal glands once branched before ending into ciliated funnels; eggs with a nutritive cell-mass. Alimentary canal and blood-vessels well developed.

A genealogical tree of the species of Bonellidae may be constructed as follows:



In the above table, side-branches represent aberrant forms. Thus aberrant *Hamingia* may have been derived from *Protobonellia* and *H. sibogae* from a form like *H. arctica*. Again *Bonellia misakiensis* and *B. miyajimai* may be considered to be aberrant departures, as in the former the female is wholly destitute of hooks and in the latter the female is characterized of supernumeral ventral hooks.

Zoological Laboratory,
Normal College, Hiroshima.
July, 1907.